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Using Educative Assessment in a Science Classroom

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I. Abstract:

The focus of this study is to consider educative assessment in the science classroom and its effectiveness in assessing student-centered learning. By using educative assessment to measure learning, student work can be evaluated by rubric in addition to a traditional summative assessment. In comparing the student learning measured using the rubric results and traditional results, there was no statistical difference between the two assessments. However, the educative assessment provided greater insight into higher levels of learning. Conversational data also showed evidence of skills-based learning in the field of science. Further research into the applications for 'at-risk' students is required.

II. Introduction:

Educators of any grade and subject are encouraged to leave behind the days of passive learning activities like lecture and note taking and incorporate more student-centered, interactive teaching methods. By shifting the focus from teacher to student-centered, the goal is to foster a learning environment that encourages deeper understanding and life applicability instead of rote memorization of superficial concepts. In order to capture the effectiveness of these changes in teaching method, however, we must also change our assessment strategy.

I have witnessed many teachers jump into student-centered lessons, but they continue to only assess student learning by an end-of-unit test. Their lessons encourage skill building, deeper understanding, and practical applications, yet the assessment is a multiple choice test of definitions and memorized facts. This disconnect between the teaching method and the assessment method is unfair for students and does not provide quality information to teachers.

Assessment is a major component in any classroom. The teacher needs to be able to understand how well their students are learning in order to make decisions on where to go next in instruction. Most of these assessments stress post-testing, or testing after learning to see what information the students have gained. Post-tests are often multiple choice with a few short answer questions, and once the tests are taken, the teacher moves onto the next topic without reflection on misconceptions or missed content.

The question my research intends to consider is whether other forms of assessment, specifically educative assessment, are more beneficial in understanding student learning and are more appropriate for a student-centered teaching method. I first learned of the term "educative assessment" from the Science Education Resource Center at Carleton College. This opened doors for bridging the gap in my classroom between my preferred teaching method and assessing my students' learning.

III. Literature Review:

Student-Centered Learning

Recent history has seen a transition from traditional, teacher-centered models to student-centered models. This change has led to improvements in support of student critical thinking skills and overall retention of material which is supported in a study comparing traditional teaching methods to student-centered teaching methods. After using the two different methods, student interviews indicated that students appreciate the student-centered instructional practices. They showed improvements in cognitive and social skills as well as ownership of their learning (Johnson & McCoy, 2011).

In a study involving middle school science students, teachers underwent professional development in student centered learning, and then applied that to their classrooms. Students completed content tests as well as surveys expressing their views of science. The study concluded that there is a positive correlation between student-centered teaching practices, student achievement, and attitudes toward science (Odom & Bell, 2015). Using student-centered instruction is positive for the learning environment in classrooms, specifically science.

The History of Assessment

Assessment is a broad term for evaluating a student's learning. More formally, Popham (2005) defines assessment as "a formal attempt to determine students' status with respect to educational variables of interest" (p. 5). Until recently, only a limited number of variables of student learning have truly been assessed. The term assessment did not even make its way into education until after World War II (Nelson & Dawson, 2013). End of unit tests were originally the most common way to judge student learning and were trademarked by high pressure on student success that led to a lot of testing anxiety.

Despite high rates of standardized testing, high stakes assessment administered by teachers within the classroom has begun to diminish in more recent years. Teachers recognize the problems with high stakes testing such as final pencil and paper exams and look for other forms of assessing student learning. In the 1990s, a trend toward multiple purposes of assessment began to appear. Assessment has now become a means to monitor student progress, providing feedback to students and parents, and teacher accountability (Bell & Cowie, 2001, p. 3). Although educators have used other types of assessment, understanding a greater purpose for assessment beyond determining what a student has learned conceptually has been the major breakthrough in teacher emphasis on a variety of assessment strategies.

Types of Assessment

While other forms of assessment have existed, the history of assessment has seen an overwhelming emphasis on assessment *of* learning, specifically learning content knowledge. This is often referred to as summative assessment. Standardized tests, end-of-unit tests, and final exams are all examples of summative assessments. According to Bloom, Madaus, and Hastings (1981), summative assessments' essential characteristics are validity and reliability. Validity refers to a test being appropriately designed based on the content and instruction given. Reliability refers to being an accurate assessment of learning despite other variables such as time of day given (pp. 72-76). Summative assessments are designed to evaluate the content learning that has been done.

The problem with summative assessments is that they are typically administered as pages of multiple choice questions with little emphasis on authentic learning. As stated by Newmann and Archbald (1992), “What counts for success in school is often considered trivial, meaningless, and contrived by students and adults alike” (p. 71). Post-assessment is often designed to test memorization of specific facts and shows little display of skills acquisition or true understanding.

While summative assessment is assessment *of* learning, teachers should also recognize assessment *for* learning. “Assessment for learning encompasses those everyday classroom practices through which teachers, peers and learners seek/notice, recognize and respond to student learning, throughout the learning, in ways that aim to enhance student learning and student learning capacity and autonomy” (Cowie, Moreland, & Otrel Cass, 2013, p. 9). In other words, assessment *for* learning is student centered and is focused on fostering student learning in all aspects of the classroom experience. It is important to note that this assessment approach is a process and not a specific task.

Assessment *for* learning typically manifests itself in two formats: formative assessment and educative assessment. These two forms of assessment overlap in their goal to benefit student learning, but the procedure of each is different. Formative assessment is defined as “the process used by teachers and students to recognize and respond to student learning, in order to enhance that learning, during the learning” (Bell & Cowie, 2001, p. 8). In using formative assessment, teachers can gauge prior knowledge and knowledge gained to adapt their teaching to accommodate for the learners in their classroom. As stated by Bloom, Madaus, and Hastings (1981), the goal is to “find ways of relating the results of the evaluation to the learning and instructional goals they regard as important and worthwhile” (p. 155).

Educative assessment, while also an assessment *for* learning, does not act as much as a probe, but as the medium for learning itself to take place. It is distinct from the typical ideals of assessment in that it looks at assessment as a way "to *educate and improve* student performance, not merely to *audit* it" (Wiggins, 1998, p. 7). Portfolios, projects, and skills development are all examples of assessments that students complete to learn material while the teacher is able to analyze the learning process.

Educative Assessment

According to Wiggins (1998), the two fundamental elements of educative assessment are authentic tasks and built-in performer-friendly feedback (p. 21). Authentic learning focuses on teaching students lessons that they can apply to daily life, encompassing assessment of "appropriate, meaningful, significant, and worthwhile forms of human accomplishment" (Newmann and Archbald, 1992, pp. 71-72). Lessons with tangible use in the present and future are more likely to be engaging and invigorating to students. The concept of authentic assessment directly relates to assessing the more meaningful and important aspects of education. Specifically considering the subject of science, the core principle is inquiry. By promoting an assessment model that aims to develop skills in inquiry, teachers have a better opportunity to help students learn science as a process and not linger in superficial learning outcomes as with brute memorization (Trauth-Nare & Buck, 2011).

In order for learning to be authentic, Newmann and Archbald (1992) conclude it must include: production of knowledge, disciplined inquiry, and value beyond evaluation (pp. 72-74). Production of knowledge is not the equivalent to reproduction of knowledge as seen with memorization. Rather authentic learning requires an environment where students can develop their own thoughts. Disciplined inquiry uses prior knowledge base and an integration of new ideas to develop into an in-depth understanding as opposed to superficial awareness. The last component, value beyond evaluation, distinguishes authentic learning from traditional learning in that “authentic achievements have aesthetic, utilitarian, or personal value apart from documenting the competence of the learner” (p. 74). In other words, it gives the content relevance to the student’s life.

Adding to the ideals of authentic learning, teachers often recognize that their students have many different learning styles, and they must differentiate instruction in order to reach all of those needs. Since educative assessment is an integral part of the learning process, it is also important to recognize that assessment of authentic learning must be differentiated in order to truly assess the students. In a study conducted about authentic learning and assessment, a teacher wrote: “After seeing firsthand the various ways that students learn and express their knowledge, I believe that there can be different types of assessment for different students at different times” (as cited in Buxton, 2006, p. 178). The individuality and personal relevance of content in students’ lives demands a variety of documentation styles to be available to the students.

The second component to educative assessment is a built-in feedback system that focusses on the student performance. The Classroom Assessment Project to Improve Teaching and Learning (CAPITAL) was a study that looked at the teacher beliefs and assessment models in a science classroom. Teachers specifically focused on their use of feedback, and the way it affected their assessment style. Upon completing the study, teachers started to shift from grade and score based assessment to ones centered on feedback. According to Cheung et al. (2006), “This shift led to student learning as *the* integral dimension of any assessment activity” (p. 209). The teachers in this study all used various methods of assessment including: peer review, rubrics, and open ended projects; however, the use of effective feedback is what made those assessment styles a success.

Educative assessment in a science classroom is often manifested through problem-based learning (PBL) and project-based science (PBS). In both of these scenarios, students are the center of the learning process, having the opportunity to use high level thinking and work collaboratively to learn. "Due to the student-centered nature of PBL and PBS, it is easy for teachers *not* to provide adequate feedback . . . However, research has shown PBL and PBS are most effective when appropriate learning goals are defined, embedded supports and feedback are part of instruction, and there are multiple opportunities for self-assessment and revision" (Trauth-Nare & Buck, 2011). The tie between authentic learning and feedback is vital in making educative assessment successful in helping students learn.

IV. Methodology:

In order to verify the effectiveness of educative assessment in monitoring authentic student learning, I taught a unit over "Drinking Water Treatment" using an educative framework as given through Wiggins (1998). My research was conducted in a seventh grade science class. Prior to teaching this unit, these students had little experience in inquiry-based learning in a science classroom. Learning in the classroom was a self-guided sequence of reading textbook chapters, taking notes, and completing worksheets. Activities and lab practices were rarely used. All summative assessments were multiple choice exams.

Based on the content of this unit, a performance-based assessment was chosen as the educative assessment. At the beginning of the drinking water unit, I introduced the performance assessment they would be completing by the end of the unit to the students. Since hands-on inquiry science was new to the students, making them familiar with the assessment helped them gain perspective on the importance of learning skills not just concepts. Throughout a ten day unit on drinking water, students engaged in problem-based learning using the 5E model and inquiry techniques. Important skills covered during the teaching of this unit include: measuring pH and hardness of water samples, using a microscope, making observations, analyzing data, and communicating results.

At the end of teaching this 10 day unit, students took a multiple choice quiz attached in Appendix A. The next two days, they completed the performance assessment attached in Appendix B. Students worked in pairs on the performance assessment due to material resource constraints. Pairs were made based on matching performances on the multiple choice quiz. The following objectives were assessed with both of these assessments:

1. Students will be able to explain the relationship between water quality and water treatment.
2. Students will be able to explain the steps of municipal water treatment.
3. Students will be able to evaluate the quality of a water sample based on concentration results.
4. Students will be able to use a microscope to observe microorganisms in water.
5. Students will be able to test the pH and hardness of water and interpret its meaning.

While students were completing the performance assessment, I recorded observations of student behavior and conversation. Each student received an engagement rating during my written observations. A score of 3 indicated high engagement in which the student participated in procedures and activities; a 2 indicated mild engagement in which the student participated with the procedures but did not participate in conversation during the assessment; and a 1 indicated that the student was not engaged during the assessment evidenced by minimal participation in procedures and little to no conversation. In addition to the engagement rating, I recorded quotations from student conversations that were applicable to the assessment and showed indication of authentic learning, evidence of scientific thinking, and/or demonstration of lab skills.

Students were individually scored according to the rubric attached in Appendix B. Upon scoring both the traditional multiple choice quiz and the performance assessment, I used a statistical t-test to test for a significant difference between the rubric scores and multiple choice test. A $p<0.5$ is considered significant.

V. Results

Quantitative Comparison

A total of 116 students completed the performance assessment and multiple choice assessment. The average score on the performance assessment was 36 points out of 40 with a standard deviation of 3.5. Figure 1 shows the distribution of scores for this assessment.

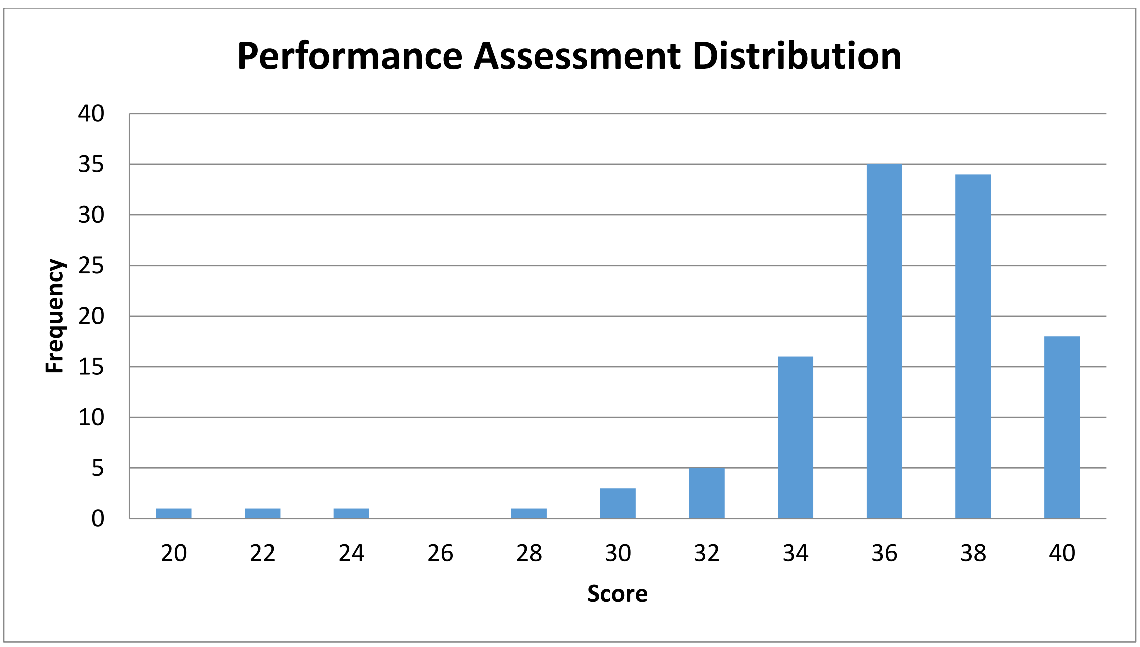

Figure 1

The average score on the multiple choice assessment was 35 points out of 40 with a standard deviation of 6.4. Figure 2 shows the distribution of scores for this assessment.

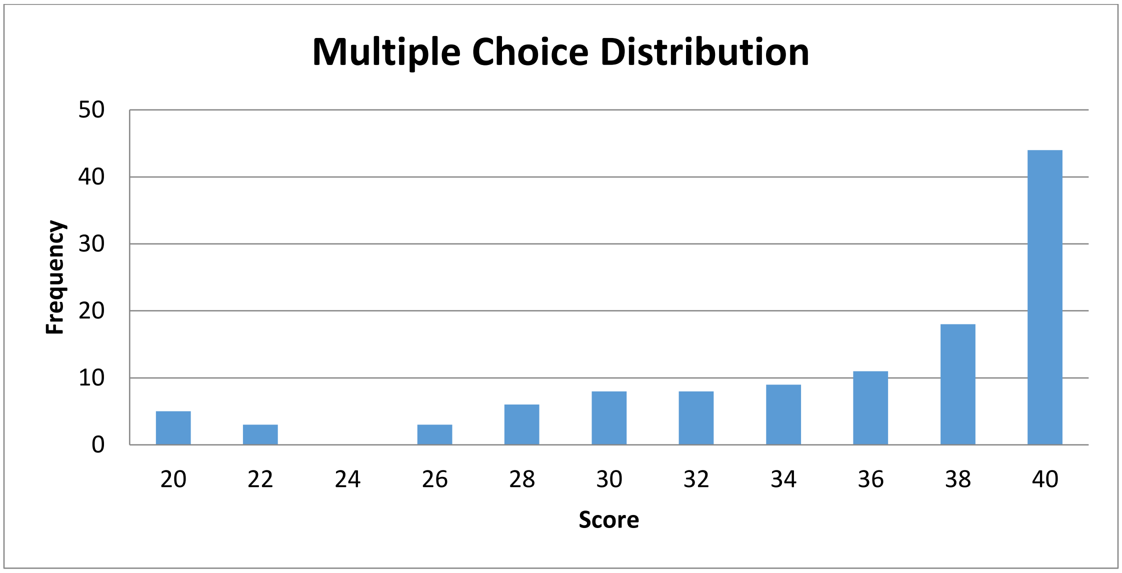

Figure 2

The two-tailed, paired t-test resulted in a *p* value of 1.984. With a significance value set at 0.5, the *p* value indicates that there is no statistical significance between the performance assessment and multiple choice assessment.

Figure 3 plots the test scores for each student. The linear regression equation is y=0.977x with an R^2 value of 0.3911. This regression further supports data from Figures 1 and 2 that the scores between the performance assessment and multiple choice test are statistically the same. The red points represented in Figure 3 are 11 students who were considered ‘at-risk’ after completeing the multiplce choice test. ‘At-risk’ refers to students who scored a raw score of 26 points (65%) or lower.

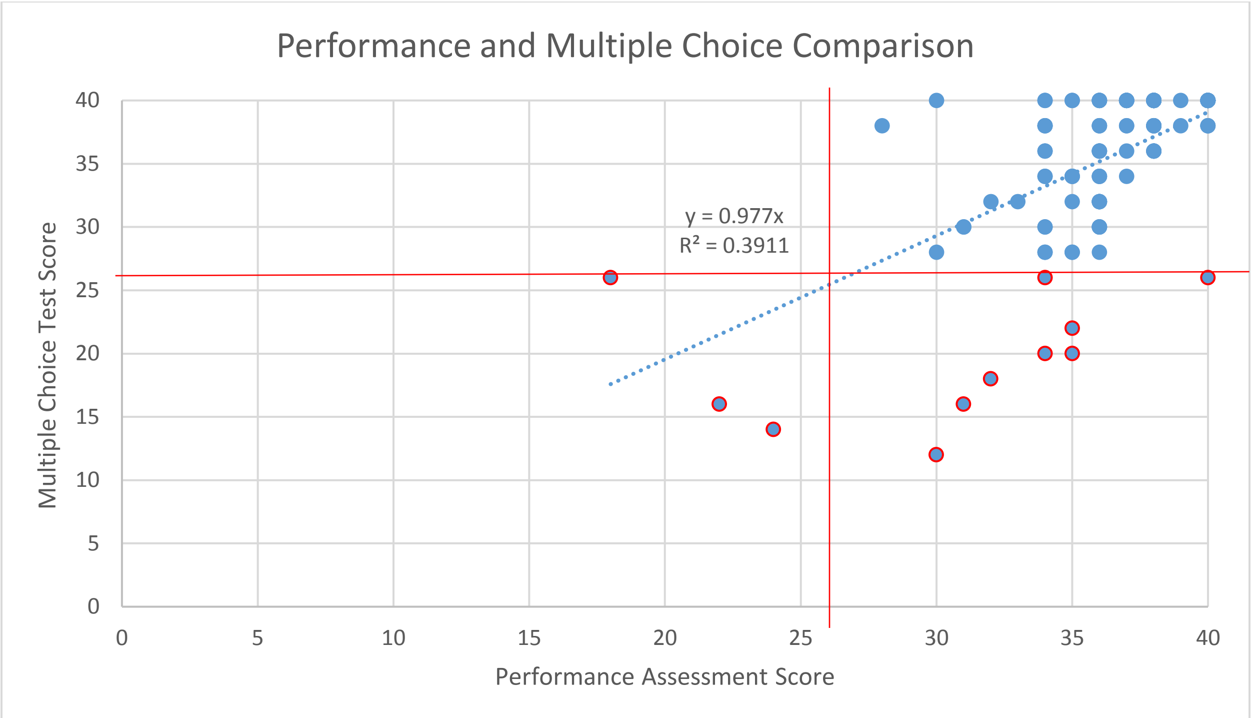

Figure 3

Unlike the overall trend of similar multiple chioce test and performance assessment scores, 10 out of 11 of the ‘at-risk’ students’ scores increased 6-18 points on their performance assessment. 8 of these increased to the point where they are no longer considered ‘at-risk’. One outlier ‘at-risk’ student’s performance score decreased.

Observational Data

Figure 4 below shows the proportional levels of engagement on a scale of 1 to 3.

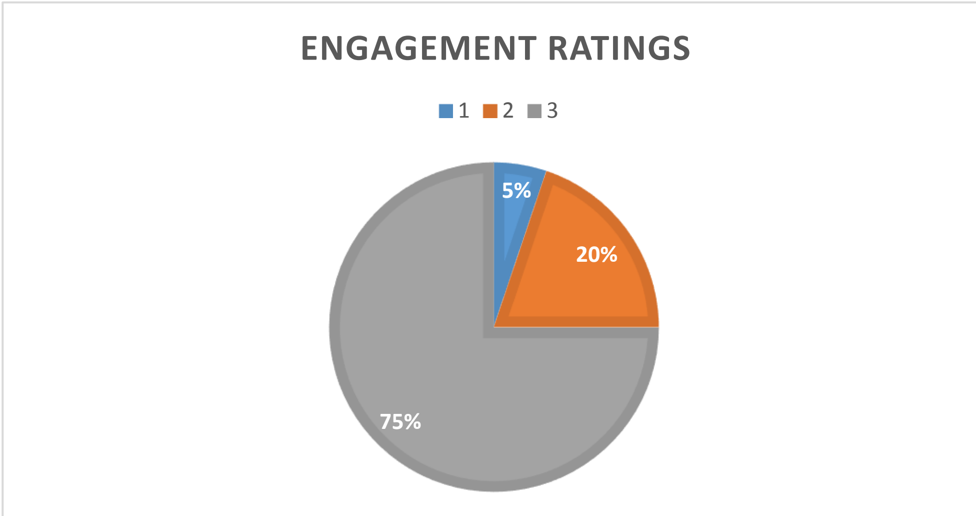

Figure 4

Note, 95% of students showed mild to high engagement throughout the performance assessment, with 75% showing high engagement.

Table 1 below lists recorded quotations (n=8) from student conversations logged by the teacher. It also codes the category the quotation demonstrates in addition to the student's scores.

Table 1

Student Quotations	Authentic Learning	Scientific Thinking	Lab Skills	Performance Score	Multiple Choice Score
"The real question we need to address is whether the quality of the water is good enough as is for the treatment plant to fix it."	x			40	40
"We can't just argue a point based on feelings. We need to look at all the information we collected to come up with an answer."		x		36	32
"Waft instead of just smelling. We don't know what is in there."			x	37	34
"I think that if the pH and hardness were better we should use this source, but they're not. Acidic water is bad for pipes and people would need to soften their water."	x	x		36	30
"Be careful not to touch the test strips with your fingers. You could ruin the results."			x	40	40
"Treatment steps is not just what we did in class. We couldn't add chlorine in class, but they still do it at the treatment plant."	x			38	40
"You're not supposed to turn the course adjustment knob thing now. You changed the magnification."			x	34	35
"Just because we saw microorganisms doesn't mean it's super dangerous. They are going to be there, but there weren't a whole lot."	x	x		36	34

VI. Discussion

The results of this study showed no statistical significance between the performance and multiple choice assessments. Despite these results, it is important to consider the levels of learning measured through each of these assessments. On the basis of Bloom's Taxonomy, the multiple choice assessment was only able to assess the lowest levels: knowledge and comprehension. The performance assessment, however, met the lower levels while also reaching higher levels of Bloom's Taxonomy including application, analysis, and evaluation. While both assessments were evaluating the same content, the performance assessment evaluated a higher level of learning within that content area. Although the scores for these assessments were not statistically different, by employing the performance assessment, I can conclude that my students were able to achieve a higher level of learning that was not assessed using the multiple choice exam.

The achievement of higher level learning is also supported through the conversational data recorded during the performance assessment. These conversations showed learning related to field authenticity, scientific thinking, and lab skills. While these are not content-based, these skills are valuable in the field of science and represent important areas of growth and learning for the students.

By accessing higher levels of content understanding in addition to the skills-based learning, performance assessments such as the one given in this study are more appropriate for assessing the full breadth of student learning. Traditional multiple choice assessments have a narrow scope and limit the communication of understanding between the student and the teacher.

Further research needs to be done in regards to the benefits of performance-based assessments for 'at-risk' students. The sample size in this study is not large enough to draw solid conclusions. The results of the 11 'at-risk' students identified, however, indicate there may be benefits for students who struggle expressing their learning through traditional methods.

In my future classroom, I definitely plan to use performance assessment and other educative assessments where applicable. The type of educative assessment will depend on the content and skills at hand. Ultimately, I believe educative assessments offer a unique opportunity for authentic learning within the field of science that traditional assessments cannot measure. Traditional assessments are appropriate for certain topics especially in gathering basic information about student comprehension and recall. However, due to the nature of science, educative assessments are invaluable in helping students share their breadth and depth of understanding and reflect on real-life applications of their work.

VII. Annotated Bibliography

Archbald, D. A., & Newmann, F. M. (1992). Approaches to Assessing Academic Achievement. In A. R. Tom (Ed.), *Toward a New Science of Educational Testing and Assessment* (pp. 71-83). Albany: State University of New York Press.

This chapter discusses the difference between authentic learning and traditional academic learning. It is presented as a direct challenge against standardized testing and offers alternative methods of assessing true learning. While authentic learning is important, the writers also include possible problems with relying on assessing achievement.

Bell, B. (2001;2000;1900;). *Formative assessment and science education*. Dordrecht; Boston;: Kluwer Academic.

This book outlines a research project conducted in New Zealand related to using formative assessment in science education. The book includes a definition of formative assessment, outlines its basic characteristics, and explains the learning benefits from formative assessment's use. It also gives a case study of using formative assessment in the classroom.

Bloom, B. S. 1., Madaus, G. F., & Hastings, J. T. 1. (1981). *Evaluation to improve learning*. New York: McGraw-Hill.

This book provides an overview of assessment strategies for the classroom. It walks through the purpose of assessment, different types of assessment, and techniques for evaluation. Although not up to date with many current assessment strategies, this book offers insight into the thoughts of assessment for learning as it was becoming more popular.

Buxton, C. A. (2006). Assessment in Support of Contextually Authentic Inquiry. *Assessment in Science : Practical Experiences and Education Research*, 173-181. Retrieved March 1, 2016

This article articulates the results of a three year research project on authentic learning in the science classroom and ways to assess that learning. In-service and preservice teachers were provided with a model for authentic science learning to use with their students. The researchers found teachers had common concern for implementing authentic learning in the midst of high stakes standardized testing. Despite this, teachers found that authentic learning and assessment empowers their students and aids in classroom community in addition to scientific literacy.

Cheung, C., Cody, A., Hirota, I., Rubin, J., Slavin, J., Coffey, J., Moorthy, S. (2006). Moving Beyond Grades and Scores: Reconsidering Assessment Feedback. *Assessment in Science : Practical Experiences and Education Research*, 207-218. Retrieved March 1, 2016.

This article describes the research done through the Classroom Assessment Project to Improve Teaching and Learning (CAPITAL). The goal of this study was to connect teacher belief system and assessment in a science classroom. An important element in this study looked at the change in mentality from grades and scores to effective feedback in assessments. The study found that teachers were willing to change their focus and recognized the importance of feedback in enhancing student learning.

Cowie, B., Moreland, J., Otrel-Cass, K., & Ohio Library and Information Network. (2013). *Expanding notions of assessment for learning: Inside science and technology primary classrooms* (1st ed.). Rotterdam;Boston;: SensePublishers.

This book outlined the importance of assessment for learning in the science classroom. It defined assessment for learning then delved into practical methods of implementing this

model specifically in a primary science and technology classroom. It also focused on increasing student autonomy and mastery based learning through assessment.

Nelson, R., & Dawson, P. (2014). A contribution to the history of assessment: How a conversation simulator redeems socratic method. *Assessment & Evaluation in Higher Education*, 39(2), 195-204.

This article describes the history of assessment and the recency of its development. The study focuses on the use of terminology in an educational setting. It also narrates the proliferation of standardized testing and the ways it has encompassed the education system and society.

Johnson, C., & McCoy, L. P. (2011). Guided discovery learning with collaborative discourse. *Studies in Teaching 2011 Research Digest: Wake Forest University*, 41-48.

This study compares traditional teaching methods to that of student-centered learning. The students engage in inquiry based activities in a math classroom then complete interviews to determine their response to the two methods. The majority of students preferred the student-center model. Through their responses, the researchers also concluded the students gain more social and cognitive skills and were able to take ownership of their learning.

Odom, A. L., & Bell, C. V. (2015). Associations of Middle School Student Science Achievement and Attitudes about Science with Student-Reported Frequency of Teacher Lecture Demonstrations and Student-Centered Learning. *International Journal of Environmental & Science Education*, 10(1), 87-98. doi:10.12973/ijese.2015.232a

This study looked at both the effectiveness of student-centered learning and teacher demonstrations in middle school science. Teachers went through profession development then implemented the techniques in their classroom. Through analysis of content exams and student surveys, the study concluded that there is a positive correlation between student-centered instruction and student attitudes and achievement in science. There is no correlation between teacher demonstration and student attitudes and achievement.

Popham, W. J. (2005). Classroom assessment: What teachers need to know. Boston: Pearson/Allyn and Bacon.

This book gives an overview of assessment in classrooms. It highlights the governmental contributions to standardized testing and how it effects the way teachers assess their students. It also delves into the importance of assessing different variables of a student's performance beyond that of paper and pencil exams. Popham breaks down different types of assessments today including performance assessment and portfolio assessment. In doing so, he explains the purpose of each, ways to implement them, and potential downsides to using these kinds of alternative assessment.

Trauth-Nare, A., & Buck, G. (2011). Assessment FOR learning. *The Science Teacher*, 78(1), 34.

In this article, the authors describe assessment for learning in a science classroom in the context of problem-based learning and project-based science. It discusses the importance of authentic learning and the use of formative assessment in implementing these teaching methods.

Wiggins, G. P., 1950. (1998). *Educative assessment: Designing assessments to inform and improve student performance* (1st ed.). San Francisco, Calif: Jossey-Bass.

This book gives an outline of the elements of educative assessment. It looks at assessing students based on practical performance and authentic learning. The author includes

information on implementing this instruction in relation to the standards, constructing the assessments, and improving the curriculum.

VIII. Appendix

A- Multiple Choice Assessment

1. What is the source Toledo's drinking water?

A. Groundwater B. Lake Erie C. Maumee River D. Toledo Reservoir

2. Which is the **least** likely source of drinking water for a large amount of people?

A. Ground B. Lake C. Ocean D. River

3. What government agency provides the standard for drinking water quality?

A. Centers for Disease Control and Prevention (CDC)
B. Environmental Protection Agency (EPA)
C. Food and Drug Administration (FDA)
D. Health Resources and Services Administration (HRSA)

4. What is the term used to describe the strength or power of a solution?

A. Coagulation B. Concentration C. Diluting D. Filtration

5. What is the term used to describe weakening a substance by adding water?

A. Coagulation B. Concentration C. Diluting D. Solution

6. Which of the following represents the **largest** amount of pollution in water?

A. 1 ppm (parts per million)
B. 1 ppb (parts per billion)
C. 1 ppt (parts per trillion)
D. 0 ppm

7. You are doing an experiment where you continue to add water to a colored solution until the color disappears at 1 ppm. At this point you can conclude which of the following?

A. The food coloring is completely gone
B. The amount is so small it is not important
C. The amount is too small to be seen, yet it is still there
D. The food coloring has evaporated

8. You are asked to make a 25% solution of red colored dye for an experiment. Which of the following would you do?

A. 15 grams of dye and 20 grams of water
B. 25 grams of dye and 75 grams of water
C. 50 grams of dye and 35 grams of water
D. 75 grams of dye and 25 grams of water

9. In the treatment process, what does the first filtration remove?

A. Large Debris B. Microorganisms C. Mud D. Trapped Gases

10. In the treatment process, what does water normally travel through during its second filtration?
A. Filter B. Lift Pump C. Screen D. Sand/Gravel

11. In the treatment process, what is the term used to describe the clumping together of dirt particles into flocs?
A. Coagulation B. Concentration C. Filtration D. Plume

12. What chemical is added to water in order to form flocs?
A. Alum B. Chlorine C. Fluorine D. Magnesium

13. What is the purpose of aeration during the water treatment process?
A. Make particles floc B. Improve the taste and odor
C. Kill microorganisms D. Remove large debris such as leaves and trash

14. What is the purpose of adding chlorine during the water treatment process?
A. Make particles floc B. Improve the taste and odor
C. Kill microorganisms D. Remove large debris such as leaves and trash

15. What is the area around a septic tank that water drains into?
A. Leach field B. Sludge C. Sewers D. Water Main

16. In the public wastewater system, where does water go after leaving a home?
A. Drainage Sewers B. Sanitary Sewers
C. Water Main D. Well

17. What describes the amount of bacteria in water?
A. Coliform Count B. Flocculation C. pH Level D. Solution

18. What may be dissolved in hard water?
A. Chlorine B. Fluorine C. Magnesium D. Sodium

19. What is a problem that may occur due to water that is too acidic?
A. Increased bacteria growth
B. Dissolve metal in the pipes causing sickness
C. Residue on fixtures such as faucets and sinks

20. What is a problem that may occur due to water that is too hard?
A. Increase bacteria growth
B. Dissolve metal in the pipes causing sickness
C. Residue on fixtures such as faucets and sinks

B- Performance Assessment

Water Treatment Assessment

Congratulations! You've been hired as a Water Quality Expert by the mayor for the new city of Grochopolis. Your first job is to find a source of water for the city. You want to find the best source that will require the least problems in treating the water and make it safe to drink. You've been assigned a partner and a sample of water to run on which to run an analysis. You could say For Grochopolis' mayor, you need to complete a report including the following components. *Remember that there are many things in water that may make people sick, and Grochians won't want to drink the water if it looks dirty and smells bad.*

Task 1: Analysis

Run an analysis on your water sample with your partner. Analyze for:

- -large debris
- -dirt and suspended particles
- -overall odor and appearance
- -microorganisms
- -pH level
- -hardness

Consider whether this is a problem and if it requires further treatment.
Organize your analysis information on the provided template.

Task 2: Treatment and Effects

Explain what steps need to be taken to treat your water sample. The step should correspond with the component it aims to remove. Be sure to use appropriate vocabulary and descriptions of the process for each component. Since pH and hardness are not typically treated at a plant, indicate at least 1 problem that may result based on your analysis.
Organize treatment recommendations or effects of results on the provided template.

Task 3: Communicate Results

Organize treatment recommendations or effects of results on the provided template. Provide reasons why you believe your source is a good or bad choice to be the source of drinking water for the city of Grochopolis. Consider whether certain treatment steps require extra work, will this extra effort increase cost, etc.

You have 2 class periods to complete this assessment.
See Rubric for graded criteria

Name: _____________________________ Period: ______
Partner's Name: _____________________ Sample #: ____

TASK 1 and 2

Component	Analysis Result	Is this a problem?	Treatment Steps
Large Debris			
Dirt and Suspended Particles			
Odor and Appearance			
Microorganisms (draw picture)			
	Analysis Result	**Is this a problem?**	**Potential Effects**
pH			
Hardness			

TASK 3

Report to the Mayor

Do you think this will be a good source of water to use? Use your analysis and treatment/effects to support your answer. You may use notebook paper if needed. Be sure to check the rubric for how this will be graded.

Water Treatment Rubric

Criteria	**Excellent (10 points)**	**Proficient (8 points)**	**Developing (6 points)**	**Unacceptable (0 points)**
Sample Analysis	Sample is analyzed accurately for all 6 components.	Sample is analyzed accurately for 3-5 components.	Sample is analyzed accurately for 1-2 components.	Sample is analyzed accurately for 0 components.
Treatment/Effects Explanation	Explanation of treatment/effects is accurate for all 6 components. Accurate is defined as correct vocabulary and description for given component.	Explanation of treatment/effects is accurate for 3-5 components. Accurate is defined as correct vocabulary and description for given component.	Explanation of treatment/effects is accurate for 1-2 components. Accurate is defined as correct vocabulary and description for given component.	Explanation of treatment/effects is accurate for 0 components. Accurate is defined as correct vocabulary and description for given component.
Results Commentary	Commentary argues position on using the water source. Support from **all** analysis components, treatment plans, and effects is provided. **A clear connection between water quality and treatment effort is made.**	Commentary argues position on using the water source. Limited support from analysis, treatment plans, and effects is provided.	Commentary argues position on using the water source. No support from analysis, treatment plans, and effects is provided.	Commentary has no position on using the water source.
Performance Skills	Student worked cooperatively with partner and engaged in analysis of the sample. Met expectations of teamwork, participation, and lab skills.	Student mostly worked cooperatively with partner and engaged in analysis of the sample. Met 2/3 expectations of teamwork, participation, and lab skills.	Student partially worked cooperatively with partner and engaged in analysis of the sample. Met 1/3 expectations of teamwork, participation, and lab skills	Student did not work cooperatively with partner and engage in analysis of sample. Met 0/3 expectations of teamwork, participation, and lab skills.

Total Score: _____/40

36-40 points=A; Performance shows excellent understanding of learning

32-36 points=B; Performance shows proficient understanding of learning

28-32 points=C; Performance shows developing understanding of learning

24-28 points=D; Performance shows emerging understanding of learning

Less than 24 points=F; Performance show little to no understanding of learning